

formed of its occurrence in Emanuel, Irwin, Ware, and Colquitt. I am still of the opinion, however, that the aggregate area of all these outcrops will not exceed one square mile or one hundredth of one per cent. of the area of the typical Altamaha, Grit region, as I estimated last year. *

COLLEGE POINT, N. Y.

LEAF-RAFTS AND FOSSIL LEAVES

BY EDWARD W. BERRY

In these modern days, with the dredging of our rivers and estuaries, the draining of our marshes and the ever-widening dumps of refuse that haunt the outskirts of our growing cities, it would seem almost as if the old-time methods by which the vegetation of bygone geological ages was preserved had become a thing of the past, and that the localities where the leaves of the present flora would stand a chance of preservation and fossilization had been usurped by the ever-spreading "white man's burden." Nevertheless, in many a more remote region, leaves, fruits and seeds are being stored away with a prodigality rivaling that of the Mid-Cretaceous or of the European Oligocene.

We are doubtless familiar with accounts of the vast rafts of vegetation which the Amazon and other tropical rivers bring down to the sea; however, these are largely driftwood like the famous Atchafalaya raft in the Mississippi, which by rough computation contained 295 million cubic feet of material and required the intervention of the state for its removal. Similar instances in more temperate climes are rarer, at least so runs the record, and I do not recall any published observations on the leaf-rafts which may be seen on the rivers of our southern coastal plain. These rafts are sometimes of comparatively large size, especially during spring freshets, at which time it is not uncommon to see them from ten to fifteen feet in diameter.

The rivers where they have been observed by the writer are the

* See *Torrey* 5 : 114. 1905 ; *Science* II. 21 : 920. 1905 ; 23 : 486. 1906.

Roanoke in North Carolina and the Great Pee Dee in South Carolina, although I have no doubt that other rivers under suitable conditions would furnish equally good examples. These conditions seem to be that there shall be a variable water content so that the autumnal fall of leaves will have a chance to form a thick carpet on the low mud-banks or exposed sand-bars of the



FIGURE 2. A stranded leaf-raft, Great Pee Dee River, South Carolina.

meandering stream, where they accumulate for weeks. With the return of high water the following spring or possibly not until summer, although the largest rafts are to be seen in the spring, they float away seaward. They are remarkably uniform in their character and contain but few sticks or foreign matter, the bulk of the material consisting of the matted leaves of the sycamore (*Platanus*), elm (*Ulmus*), birch (*Betula*), and the willow and chestnut oaks, with a considerable admixture of other species, including the more rapidly decaying leaves of the sweet gum and other trees that haunt the river banks.

These rafts furnish a most perfect illustration of one of the

ways in which leaves sometimes become fossilized, and carry us back to the fossil leaf-beds which are so common in the Cretaceous of the coastal plain. The foregoing rivers carry much sediment, especially during periods of high water, so that when the raft finally becomes waterlogged and sinks in some quiet place or is stranded on the sand-bars of some river cove like the one in the center of the illustration, the river mud soon covers it and we have an incipient clay bank with abundant leaf impressions and layers of lignified leaves several inches in thickness. The flood plains of these rivers, both ancient and modern, abound in such leaf beds going back to the Pleistocene, if, indeed, it be possible to draw the line and say where the Pleistocene ended and the recent deposits began. The leaves do not help us greatly in this respect, for deposits of undoubted Pleistocene leaves are practically all of species still existing, although in some cases they may be of species not common to the region at the present time, or the deposits may lack some of the common riverside forms of the present.

Unfortunately, good photographs were not secured of any of these leaf-rafts in midstream, and the accompanying illustration from a photograph taken on the Great Pee Dee river shows a stranded raft which was about fifteen feet long and whose true nature was carefully verified. It was still floating so that if the background be eliminated a good idea is gained of the appearance of these rafts.

This is, of course, only one of the many methods by which leaf remains are stored away. The many swamps along the lower reaches of these same rivers abound in beds of vegetable material often many feet in thickness, and doubtless represent in a general way the method of formation of the lignitic material in such formations as the Montana and Laramie, as well as furnishing us with a picture of the physical conditions and elevation of the land during that period when the Mississippi gulf finally retreated from the great interior region of the United States. They also serve admirably to refute the now antiquated notion that peat is formed only in high latitudes.